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Title

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Permalink

<https://escholarship.org/uc/item/7234g143>

Journal

AJP reports, 1(2)

ISSN

2157-6998

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Publication Date

2011-12-01

DOI

10.1055/s-0031-1285982

Peer reviewed

Acute Fetal Anemia Diagnosed by Middle Cerebral Artery Doppler Velocimetry in Stage V Twin–Twin Transfusion Syndrome

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ABSTRACT

In stage V twin–twin transfusion syndrome (TTTS), up to 50% of surviving twins die or experience permanent disabilities, likely due to acute intertwin hemorrhage resulting in sudden severe anemia of the survivor. Although fetal middle cerebral artery (MCA) Doppler studies demonstrate strong correlation with fetal hemoglobin values, acute hemorrhagic events are more difficult to diagnose, and optimal timing of delivery of the survivor poses an obstetric dilemma. We report a case of newly diagnosed stage V TTTS at 28 weeks gestation, complicated by acute severe anemia diagnosed by significantly abnormal fetal MCA Doppler studies. The anemic twin was urgently delivered and is doing well without significant sequelae.

KEYWORDS: Fetal anemia, fetal demise, Doppler velocimetry, twin–twin transfusion syndrome

Acute inter–twin hemorrhage in stage V twin–twin transfusion syndrome (TTTS) may be diagnosed using middle cerebral artery (MCA) Doppler velocimetry.

CASE REPORT

A 27-year-old gravida 3, para 1 at 23 weeks and 4 days of gestational age with a spontaneous monochorionic, diamniotic twin gestation presented to our institution for threatened preterm labor. Ultrasound evaluation upon admission revealed previously unknown stage I TTTS in otherwise anatomically normal female fetuses. The donor twin was noted to be a classic “stuck twin” without a measurable fluid pocket; the recipient showed severe

polyhydramnios with a deepest vertical pocket (DVP) of >13 cm. Over the course of 9 days of hospitalization, three amnioreduction procedures were performed removing 900, 1400, and 1000 mL of amniotic fluid, respectively. The patient received magnesium sulfate tocolysis and betamethasone for fetal lung maturation. Her preterm labor resolved, and she was discharged home undelivered with close outpatient follow-up. Serial ultrasound examinations were performed and noted no progression of TTTS by Quintero staging criteria. However, the fluid discrepancy, particularly the amount of polyhydramnios, remained significant with 1.6- to 1.9-cm pockets in the donor and 11- to 13-cm pockets in the recipient twin. Five additional amnioreduction procedures were performed for maternal symptomatic relief

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Received: January 30, 2011. Accepted after revision: June 20, 2011. Published online: August 3, 2011. DOI: <http://dx.doi.org/10.1055/s-0031-1285982>. ISSN 2157-6998.

and improvement of the DVP in the donor to 6.5 to 6.8 cm was noted. At 28 weeks and 6 days of gestation, 2 days following a routine ultrasound evaluation that showed a DVP of 6.7 cm in the donor and 13 cm in the recipient twin as well as normal umbilical artery Doppler with a systolic to diastolic (S/D) ratio of 2.0 in the donor and 2.8 in the recipient, stage V TTTS was diagnosed with demise of the donor twin. The surviving recipient twin was noted to have a mildly increased umbilical artery S/D ratio of 4.9 with positive end-diastolic flow. Fetal heart rate tracing revealed minimal variability with intermittent variable and rare late decelerations. Repeat ultrasound evaluation after transfer to the labor and delivery unit included a fetal MCA peak systolic velocity (PSV) measurement and showed a marked increase to 2.27 multiples of the median (MoM) for gestational age.

Given the sudden progression and clinical symptoms of acute anemia in addition to a worsening fetal heart rate tracing, the decision was made to proceed with urgent repeat cesarean section. The demised donor twin A weighed 1206 g. The surviving twin B weighed 1365 g with Apgar scores of 1 at 1 minute and 8 at 5 minutes (cord blood gases: arterial pH 7.31; pCO₂ 44.9 mm Hg; pO₂ 13.6 mm Hg; HCO₃ 22.0 mmol/L; base excess -4; O₂ saturation 14.2%; venous pH 7.38; pCO₂ 39 mm Hg; pO₂ 30.4 mm Hg; HCO₃ 22.3 mmol/L; base excess -3; O₂ saturation 56.7%). The newborn was pale and immediate blood analysis confirmed acute anemia with a hemoglobin of 8.1 g/dL and a hematocrit of 27.8%. She was intubated and received 15 mL of type O-negative packed red blood cells. Maternal Kleihauer-Betke test was

negative for indices of fetomaternal hemorrhage. Placental pathology demonstrated meconium-pigmented macrophages in the placental membranes, a velamentous cord insertion, a false knot, and generalized pallor. Multiple small artery-to-vein anastomoses were noted.

The infant's neonatal intensive care course was uncomplicated with the exception of a few typical complications of prematurity: mild hyperbilirubinemia and a short course of necrotizing enterocolitis were medically managed. At her 11-month follow-up, she met all developmental milestones and had not required additional specialist care.

DISCUSSION

TTTS complicates 10 to 15% of monochorionic twin pregnancies.¹ The underlying pathophysiology involves unbalanced blood flow through placental vascular anastomoses. Stage V TTTS—defined as death of at least one twin—occurs in 32% of such pregnancies.² When not treated with laser ablation or another interventions, ~50% of surviving twins die or experience permanent disabilities.³ Such disabilities are likely due to acute hemorrhage from surviving twin to deceased twin, resulting in severe anemia and ischemia-related damage, such as periventricular leukomalacia.⁴ These hemodynamic changes have been observed fetoscopically within 3 hours of initial twin demise.⁵ Morbidity and mortality associated with significant preterm birth—occurring in ~68% of these cases—are difficult to distinguish from the sequelae of acute ischemia.⁶ Given that the average

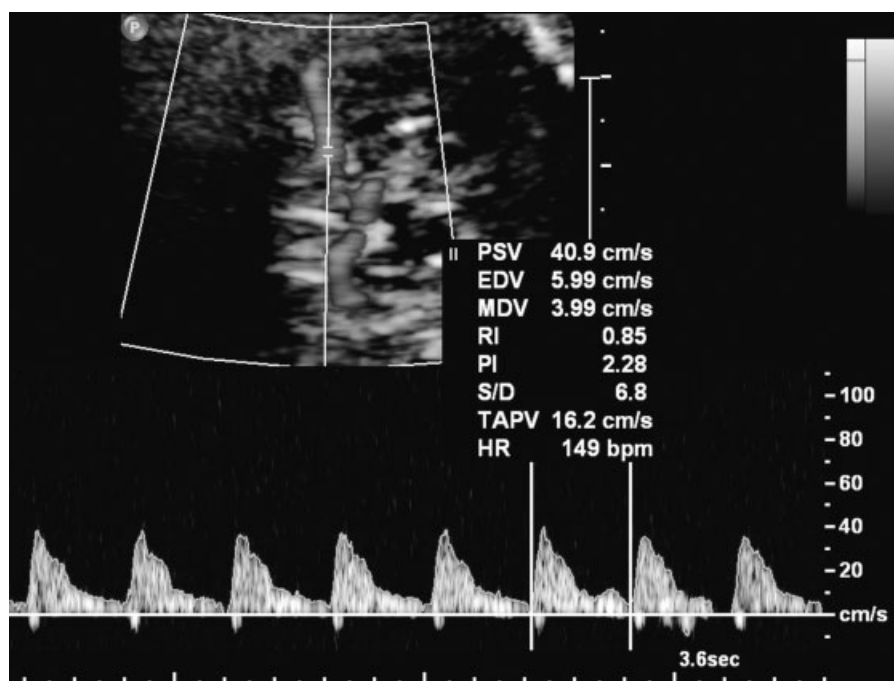


Figure 1 Example of a normal middle cerebral artery peak systolic velocity measurement of 40.9 cm/s or 1.27 multiples of the median by Doppler ultrasound at 25 weeks gestational age.

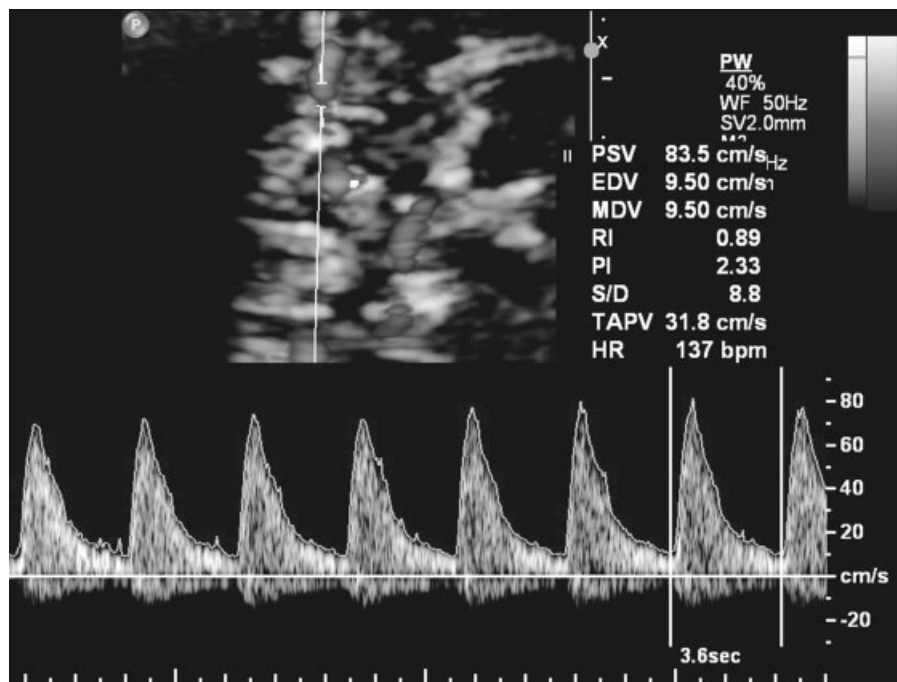


Figure 2 Example of an abnormal middle cerebral artery peak systolic velocity measurement of 83.5 cm/s or 2.06 multiples of the median by Doppler ultrasound at 30 weeks gestational age indicating fetal anemia.

gestational age at which death of the first twin occurs is 24 weeks,⁷ management of the surviving twin poses an obstetric dilemma. In our case, elevated fetal MCA Doppler PSV was used in the scenario of stage V TTTS to diagnose an acute intertwin hemorrhage. This ultimately led to delivery of a 28-week fetus due to concerns for impending fetal compromise and resulted in good long-term outcome.

TTTS in the lower stages is considered a chronic fetal condition that may be expectantly managed with careful observation to avoid complications of prematurity.¹ Invasive procedures such as laser photocoagulation are not usually recommended for treatment in stage I TTTS.² Sudden progression to a significantly higher stage is rare but associated with significant morbidity and mortality.¹ In a very premature gestation as represented by our case, the decision to proceed with delivery rather than continue with expectant management or treatment by fetal transfusion must be carefully weighed. Because we could rely on a well-documented normal ultrasound just 2 days prior to the sudden deterioration, we were able to use the acute change manifested in the pathologically elevated fetal MCA Doppler measurement as an indicator of fetal compromise and make the decision to deliver urgently. We believe that despite the premature gestation, this rapid intervention and the subsequent neonatal transfusion led to the ultimately good outcome. Fetal MCA PSV of 1.5 MoM and greater has demonstrated 90% sensitivity and specificity for the prediction of moderate or severe fetal

anemia⁵ (Figs. 1 and 2). The critically elevated value in this instance was likely due to reversal of blood flow through the anastomoses to the demised twin leading to anemia, as has been described previously in the literature.⁴ A few prior reports have discussed similar cases and avoided premature delivery by performing cordocentesis and rescue intrauterine transfusions.⁸ We argue that urgent delivery was likely preferable in our scenario, given the mixed reported results of such transfusions and the already compromised fetal heart rate tracing. Although we will not always have the luxury to be able to evaluate a twin pair with TTTS immediately at the time of demise of one twin to be able to intervene quickly and prevent demise or damage of the survivor, we believe that our case demonstrates how fetal MCA Doppler studies, even without corroboration by fetal blood sampling, can provide valuable information and may be integrated into the management of this rare but devastating complication. Physicians, sonographers, and parents of affected pregnancies should be aware of this possible outcome and have an emergent treatment plan in effect that should include immediate evaluation of the MCA Doppler PSV.

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